Cosmetic powder from natural feed-stock waste as alternative to microplastic powders

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Abstract

With upcoming regulations limiting the use of several specific cosmetic powders in leave on applications due to their classification as microplastics, there is a need to find alternative powders that could replace those cosmetic powders longer term. Silica from rice husk origin is a natural and sustainable solution that can deliver optical benefit together with a good sensorial benefit. The silica is outside of the proposed European microplastic restriction on solid polymers and meets multiple trends such as non-GMO, natural origin and upcycled ingredient.

The purpose of this paper is to share how a cosmetic powder derived from a natural feed-stock waste can match or even exceed optical and sensorial benefits of the synthetic powders currently used in skin care and color cosmetic formulations. The evaluations generated on the neat rice husk powder and in formulations showed that it can bring multiple benefits such as water and sebum absorption, skin imperfections masking and compaction properties. In addition, this new silica has a smooth feel compared to traditional mineral sourced silicas that typically leave a dry after feel on skin upon application.

The rice husk cosmetic powder provides skin imperfection masking benefits (also called blur) in formulation by modifying the intensity of scattered/reflected light from the surface on which skin care products are applied. The higher the blur, the stronger the skin imperfections masking ability. This light scattering effect results in skin appearing more uniform, with less wrinkles, fine lines and pores. Several in-vitro tests were carried out to characterize the light profile changes resulting from dispersing the rice husk powder either into the water or the oil phase of an oil-in-water emulsion. The optical profile was quantified through two main parameters: total light transmission percentage (translated in-vivo into a natural skin tone) and haze value (translated in-vivo into skin imperfections blur). Both parameters were measured on a standardized thickness wet film formed by coating the oil-in-water (o/w) formula onto a glass slide and allowing it to dry. The minimum screening thresholds considered were 70 and 93% for haze value and total light transmission, respectively. Formulas meeting those two requirements were then evaluated in-vivo by several panelists to confirm immediate skin imperfections masking benefits. In-vitro evaluations showed that adding the rice husk powder into oil-in-water emulsion or anhydrous formulations was associated with a significant increase of the haze value. When used at 1.5% in an oil-in-water formulation, a higher haze value was obtained compared to both a hydrophobic mineral sourced silica formulated at the same use level but also polymethyl methacrylate (PMMA) or Nylon-12 cosmetic powders used at 3 % use level.

The sebum and water absorption properties of the risk husk powder were evaluated in-vitro. The principle of the test method used is to add respectively artificial sebum or water drop by drop to a standardized amount of powder and mixed to allow complete absorption. The amount of sebum or

water absorbed is recorded per gram of rice husk powder. The trials demonstrated that the rice husk powder absorbs more water and artificial sebum than the mineral sourced silica, PMMA or Nylon-12 powder.

The compaction property of the rice husk powder was also evaluated. The neat powder was added in metal cups submitted to a pression of 1.5 Tons, then dropped 3 times from a 30 cm height. The lower the weight loss, the higher the compaction property. The rice husk powder had < 1 % weight loss which can be translated into good binding property in formulation.

Whether evaluated in neat form or in formulation, the rice husk powder was shown to combine superior optical benefits (soft-focus and in-vivo sebum absorption, compared to the mineral sourced silica evaluated) and a sensory profile similar to PMMA and Nylon powders typically used in Personal Care. Considering in addition its sustainable profile, this new silica is an attractive alternative for use into a large range of personal care formulations, being particularly relevant for those with a natural positioning.

Keywords: rice husk, natural feedstock, optical effects, sensory benefits, sustainable

Introduction

The purpose of this paper is to demonstrate how a cosmetic powder derived from a natural feed-stock waste can bring similar or exceed optical and sensorial benefits compared to synthetic cosmetic powders currently used. Hence silica from rice husk origin can be a good alternative to microplastic powders since silica is outside of the proposed European microplastic restriction on solid polymers. The in vitro screening and in vivo evaluations generated on the neat silica powder derived from rice husk as well as in oil-in-water formulations showed that this silica can bring multiple benefits in formulations, such as but not limited to, water and sebum absorption, skin imperfections masking (fine lines and wrinkles), skin mattifying for a natural skin tone and flawless look, pores appearance minimizing. The sensory profile of this silica is also very interesting as it brings a very smooth feel to skin compared to other mineral sourced silicas, combining a good optical benefit and a dry after-feel when the formulation or neat powder is rubbed onto the skin.

Materials and methods

The silica described in this document is produced using rice husk as a feedstock, a waste generated from the rice cultivation. Its production from a renewable source offers strong advantages in comparison with conventional methods of producing silica from sand and quartz. The sustainable process extracts significant value from rice husk, whether from an energy or silica source standpoint, reusing what was previously considered as a waste, aligned with current environmental and sustainable objectives for cosmetic raw material suppliers. This amorphous silica (also called precipitated silica) is associated with INCI name *silica* (rice husk origin).

The soft-focus method is designed to assess the light scattering power of a powder, being the capability of said powder to reflect light on skin and decrease appearance of fine lines or pores. The in vitro measurements are realized with Haze-Gard equipment which is used to allow a fast screening

for the soft-focus properties. The cosmetic formulation (37 microns wet film) is coated onto a glass slide and let dry for 15 minutes. Three measures of the total light transmission (TT) and the haze (H= 100 X (T diffused/T total) are taken per glass slide. The measure is made using duplicates (2 glass slides per formulation). The mean average and standard deviation are recorded. The higher the haze value combined with high total transmission %, the higher the soft focus or blur. To have promising blur benefit, the haze value must be minimum 70.

To quantify (in-vitro) the sebum absorption property of a cosmetic powder, a solution of artificial sebum is prepared. 1g (or less pending on the density) of the powder to be evaluated is weighed in a cup. The artificial sebum is added drop by drop to the powder and mixed with a spatula to allow the sebum to be absorbed by the powder. The amount of sebum absorbed is recorded after each drop. The test is completed when the powder does not absorb anymore the liquid and start to look shiny. Similar procedure is followed for the water absorption benefit assessment.

The sebum level evaluation (in-vivo) is designed to assess the ability of neat or formulated products to modify the level of fatty material present on skin. It is assessed on a human panel with oily forehead, using the Sebumeter MPA5 (Courage + Khazaka, Köln, Germany). The instrument expresses the results in µg sebum/cm^2 skin, but results are expressed as percentage of sebum.

The sensory profile of the powder is evaluated by applying 20 mg of an o/w formulation containing the powder to evaluate onto pre-defined sites on the panelist forearms. Each panelist rubs the two products with a separate finger and rates the selected parameters before and after absorption onto the skin. The test is performed by a minimum of 18 panelists in a climatic room where the temperature and relative humidity are standardized. The statistical treatment of the data is made using a specific software named FIZZ.

Results and discussions

In order to quantify the soft-focus benefit, the rice husk cosmetic powder was formulated into an oil-in-water (o/w) chassis, documented in table 1. A key advantage of the rice husk silica is the possibility to be dispersed in both phases (oil and water). The haze values have been measured on the film made with this o/w formulation and are illustrated in figure 1 and 2.

Phase	**INCI name**	**Wt%**	**Wt%**
A	Aqua	63.65	65.15
	Xanthan Gum	0.6	0.6
	Disodium EDTA	0.05	0.05
	Glycerin	5.0	5.0
	Silica (rice husk origin) or PMMA or Nylon-12 powder	**1.5**	-
B	Glyceryl Stearate (and) PEG-100 Stearate	0.75	0.75
	Sorbitan Stearate	1.75	1.75

	Caprylic/Capric Triglyceride	2.0	2.0
	Silica (rice husk origin) or PMMA or Nylon-12 powder	-	**1.5**
	Dimethicone	24.0	22.5
C	Phenoxyethanol (and) Ethylhexylglycerin	0.7	0.7

Table 1: Oil-in-water (o/w) formulation

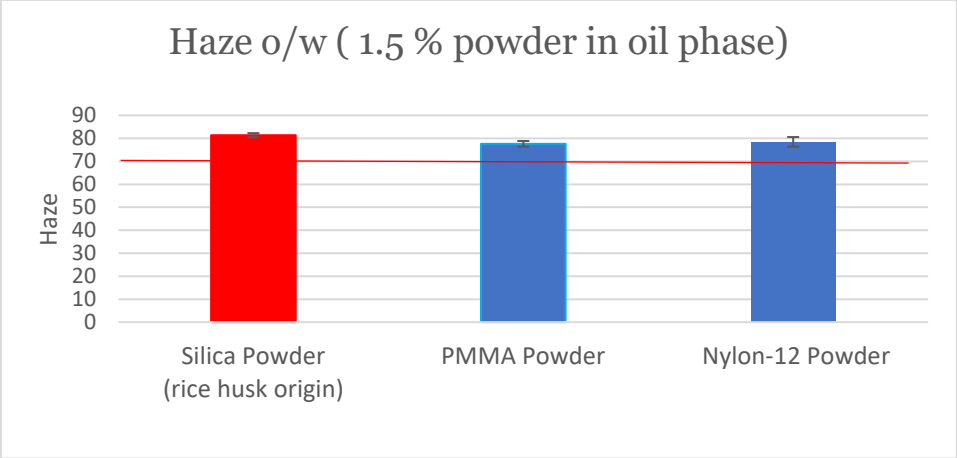

Figure 1. Haze values for oil-in-water formulations

The silica powder from rice husk dispersed in the oil phase at 1.5 % in a standardized oil-in-water formulation was tested for its optical benefit using a hazemeter equipment. The haze value obtained is around 80, which is higher than the minimum haze value needed to pass the Haze test (70). This value of 80 translates into a high probability for in vivo skin imperfections masking. The haze value for the PMMA and Nylon-12 powders were slightly lower than the haze obtained with the silica.

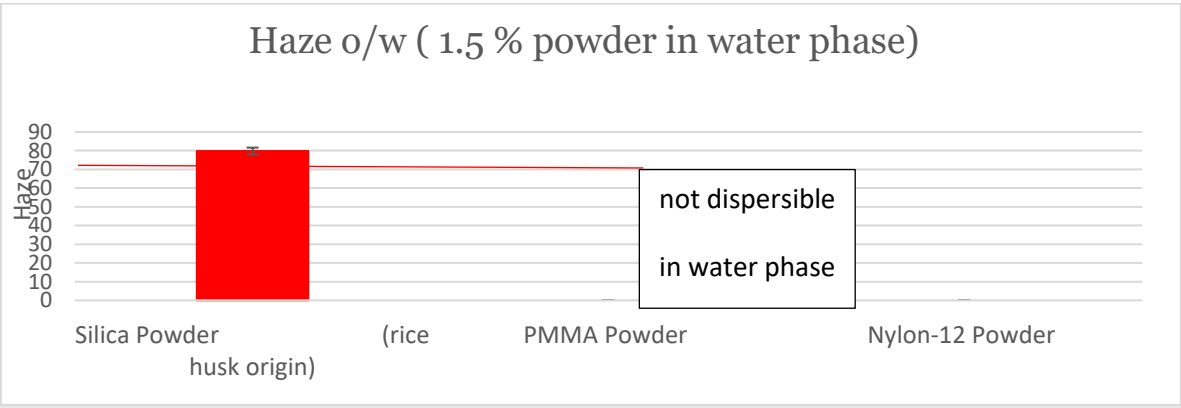

Figure 2. Haze values for oil-in-water formulations

The silica powder from rice husk dispersed in the water phase at 1.5 % in a standardized oil-in-water formulation was tested for its optical benefit using a hazemeter. The haze value obtained is also around 80. PMMA and Nylon-12 Powder could not be homogeneously dispersed in the water phase and could not be measured.

The amount of water that each powder could absorb was evaluated and shown in figure 3. The results show that the silica powder (rice husk origin) was able to absorb more water than the PMMA and Nylon-12 powder.

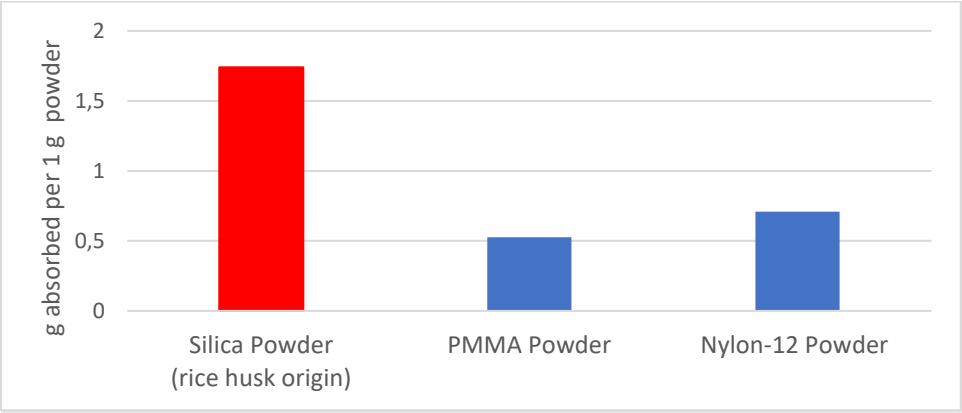

Figure 3. Water absorption per 1 g powder

The amount of sebum that each powder could absorb was evaluated in vitro and illustrated in figure 4. The results show that the silica powder (rice husk origin) was able to absorb more sebum than the PMMA and Nylon-12 powder.

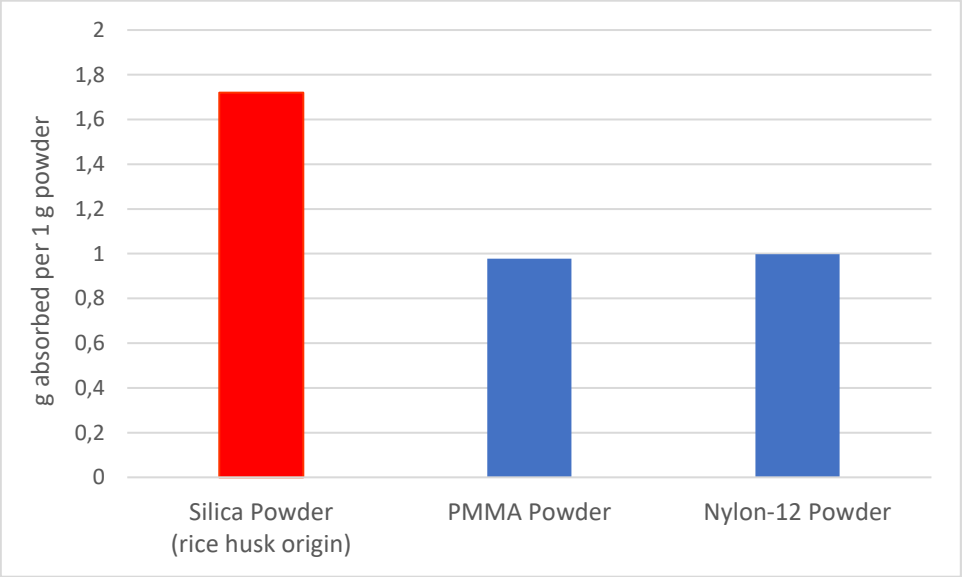

Figure 4. In vitro Sebum absorption per 1 g powder

The sebum absorption of the silica powder (rice husk origin) was also tested in vivo on panelists forehead. The powder was first formulated at 2 % in a hydrogel formulation. 50mg of the hydrogel was applied on the panelist's forehead and the amount of sebum is quantified over time using the sebumeter. Figure 5 illustrates the percentage of sebum versus a non-treated site in function of time. After 4 hours, the level of sebum started to increase again.

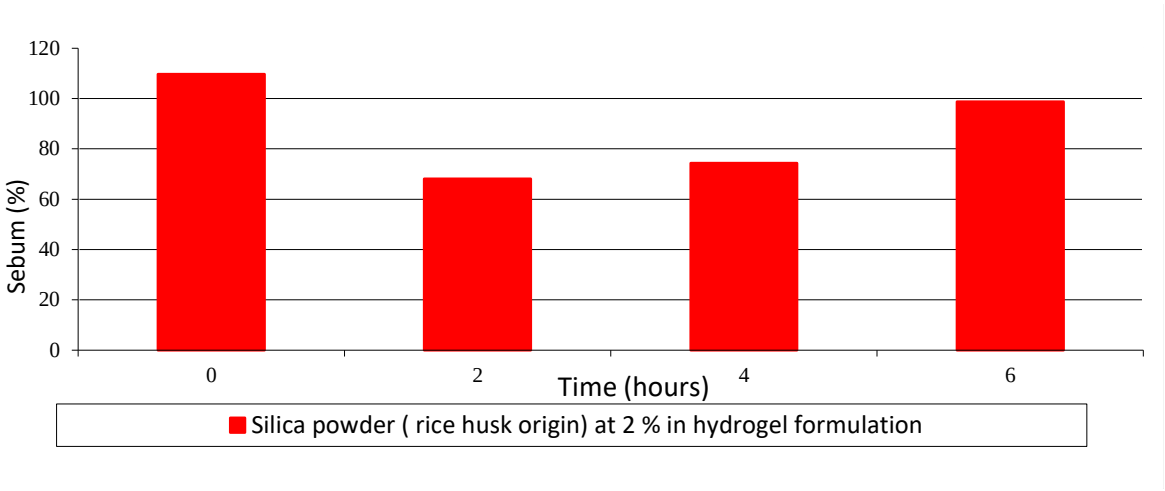

Figure 5. In vivo sebum absorption results

The Silica Powder (rice husk origin) and the Nylon-12 Powder were formulated at 1.5 % in the oil-in-water formulation. 20 mg of both emulsions were applied on 18 panelists forearm. They rubbed the emulsions and rated the three parameters documented in figure 6 before the emulsion was absorbed onto the skin. The panelists could not perceive any statistical difference between the two emulsions for spreadability, absorbency and tackiness.

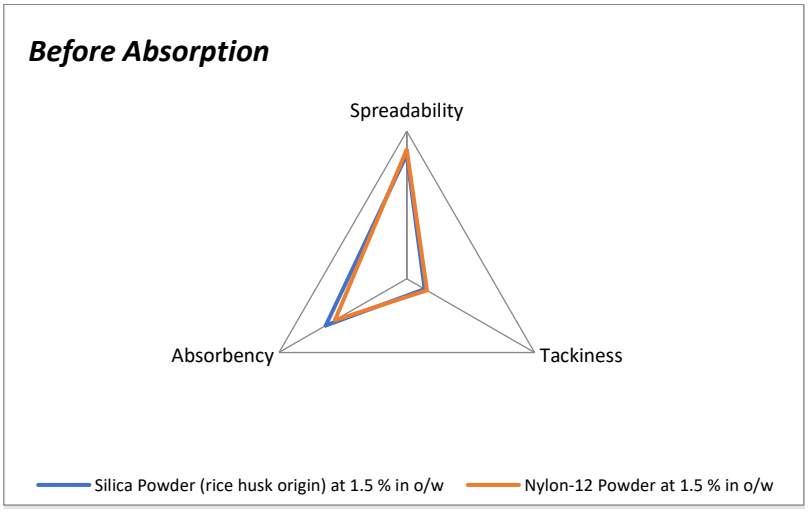

Figure 6. Sensory parameters before absorption onto the skin

The parameters illustrated in figure 7 were then evaluated by the panelists after the emulsions were absorbed onto their skin. The emulsion containing Nylon-12 powder was found to be greasier and with more film residue at 95 % confidence level. The smoothness and slipperiness of both emulsions were not found to be significantly different, meaning that the silica powder could be a good alternative to Nylon-12 powder.

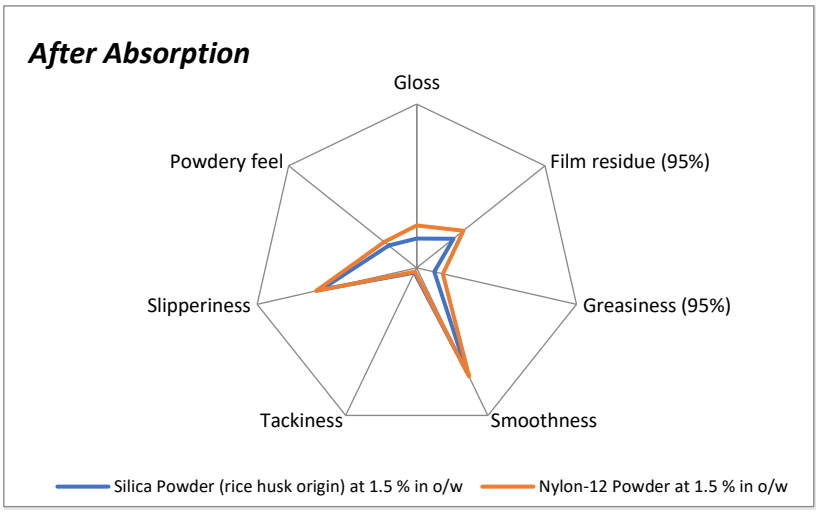

Figure 7. Sensorial parameters after absorption onto the skin

The same sensory evaluation was conducted comparing with PMMA powder and shown in figure 8 and 9. Panelists could not perceive any statistical difference between the two emulsions for spreadability and tackiness but found the emulsion containing the PMMA powder faster absorbed at 95 % confidence level.

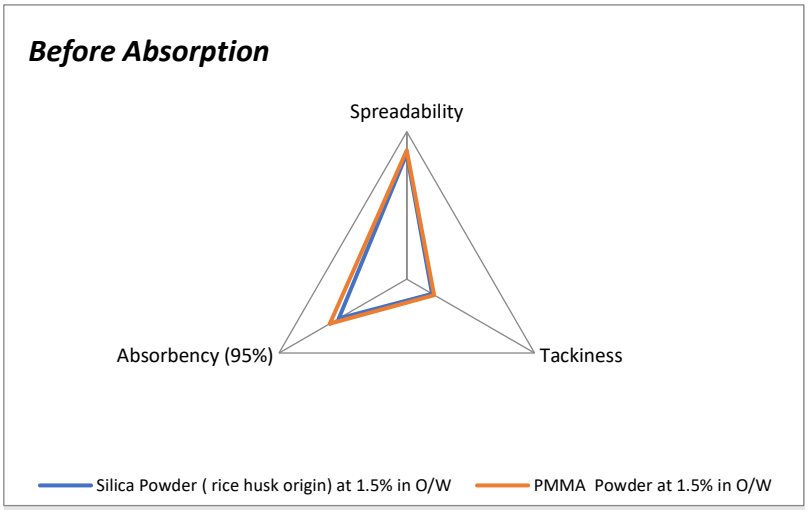

Figure 8. Sensorial parameters before absorption onto the skin

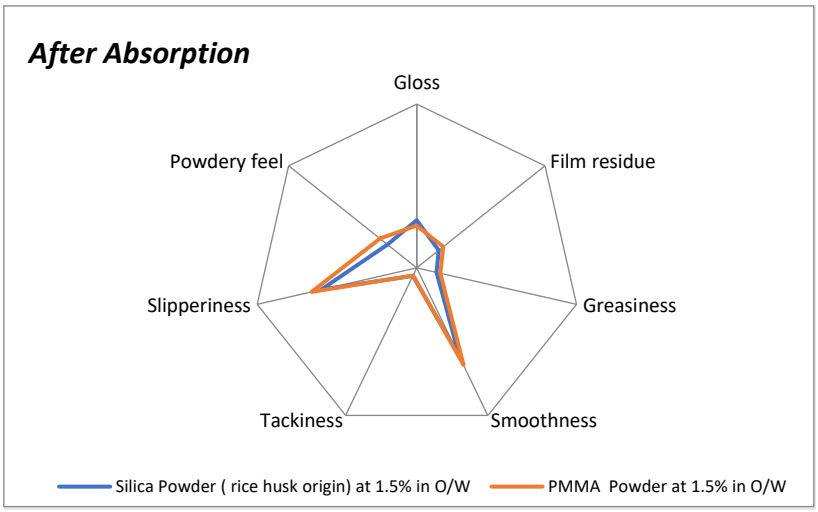

Figure 9. Sensorial parameters after absorption onto the skin

After absorption, panelists could not perceive any statistical difference between both emulsions. The smoothness and slipperiness of both emulsions were found similar meaning that the silica powder could be a good alternative to PMMA powder.

Conclusion

It was demonstrated that the silica powder from rice husk origin has a superior optical benefit (soft-focus) while having a similar sensory profile to typical PMMA and Nylon powders used in Personal Care. It can advantageously be formulated in both the oil and in the water phase, allowing for a broader use and a higher flexibility in different hydrous or anhydrous formulations. It could also be a good alternative to powders considered as microplastics.

Acknowledgments.

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Conflict of Interest Statement. NONE.